Al-Farabi Kazakh National University

Faculty of Biology and Biotechnology

Department of Molecular Biology and Genetics

Final Assessment Program
for Course ID 2149 Genetic engineering
"6B05105 - Genetics"

Almaty

The final assessment program for discipline ID 2149 Genetic engineering under the educational program "6B05105 - Genetics" was compiled by Amirova A.K., position associate professor, PhD in biology.

Reviewed and approved at a meeting of the Department of Molecular Biology and Genetics

From “21” 05 2025, protocol No.22

Head of the Department Zh. K. Zhunusbayeva

Introduction

Exam format: standard written, IS Univer offline.

The exam will consist of three questions:

Question 1 includes cognitive competence questions that assess knowledge and understanding of the subject matter and is worth 30 points.

Question 2 includes functional competence questions that assess the ability to apply and analyze information and is worth 30 points.

Question 3 includes systems competence questions that reveal the ability to synthesize and evaluate information and solve problems in medical genetics and is worth 40 points.

The exam is conducted according to the summer session schedule of the Faculty of Biology and Biotechnology. The exam schedule is posted in the Univer system. The exam format is a traditional standard offline format, according to the classroom schedule. Students take the exam "here and now" in real time.

The written exam process involves the automatic generation of an exam question, to which they must provide a written answer. Proctoring is mandatory for the written exam. Video recordings of the exam are stored for three months after the end of the session.

The exam schedule (date, time, and room) is posted in advance in the Univer system. Exam duration: 2 hours.

Exam proctoring is used.

Exam Procedure. 1. The student enters the classroom 20 minutes before the exam, presents identification, and signs the attendance sheet. They take their assigned seat and are seated. At the beginning of the exam, the student receives a ticket from the instructor on duty and answers the questions on the ticket on the provided sheets. Bringing anything into the classroom except identification and a pen is prohibited.

Attention! Students are not allowed to open their ticket before the exam begins. After completing their answer, they hand in their answer and leave the classroom. The instructor on duty forwards all answers to the dean's office, where they are coded and submitted to the examination committee for review. Before the exam begins, the instructor on duty greets the participants and warns them against using additional sources of information. They periodically remind them of the remaining time remaining.

Guidelines for completing the assignment

Block I

1. Introduction. The purpose and objectives of genetic engineering.
2. The history of the development of genetic engineering technologies.
3. Vectors are special devices designed to deliver foreign genes to various organisms.
4. Enzymes used in genetic engineering.
5. Restriction enzymes and DNA ligase.
6. Marker genes: selective genes, reporter genes.
7. Phage and cosmid vectors.
8. Enzymes used in genetic engineering.
9. Recombinant DNA technology.
10. Methods of gene cloning.

Block II

1. Creation of a genomic library.
2. The Cytochrome P450 Family.
3. Transgenic industrial products.
4. Industrial production of insulin and other valuable medicines.
5. Preparation and defense of a presentation.
6. Methods of genetic transformation of plant protoplasts, cells and tissues.
7. Construction of the *Agrobacterium tumefaciens* Ti plasmid.
8. Introduction to the PCR method.
9. Plant transformation method using *Agrobacterium tumefaciens*.
10. Regulation of the production of genetically modified organisms.

Block III

1. Myths about the dangers of transgenics.
2. Biolistic transformation of plants.
3. The principle of operation of the gene gun.
4. Methods of genetic transformation of animals.
5. Legislation in the field of GMOs (domestic, foreign), patenting (legal regulation of the creation and use of GMOs).
6. Recombinant DNA and hereditary diseases.
7. RNA interference: mechanism of action and prospects for use in medicine.
8. Mechanisms of gene expression regulation in prokaryotes and eukaryotes.
9. Gene therapy.
10. Personalized medicine.

Thematic program of final assessment

The first block includes questions on cognitive (knowledge) competence, assessing knowledge and understanding of the subject matter. This task allows students to demonstrate knowledge of the purpose and objectives of genetic engineering, history of the development of genetic engineering technologies, vectors are special devices designed to deliver foreign genes to various organisms, enzymes used in genetic engineering. restriction enzymes and DNA ligase, marker genes: selective and reporter genes, phage and cosmid vectors, enzymes used in genetic engineering, recombinant DNA technology and methods of gene cloning. The assignment is worth **30 points.**

The second block includes questions on functional competence, assessing the ability to apply and analyze information and systematize research results by processing literary data. This task is designed to demonstrate knowledge of the creation of a genomic library, transgenic industrial products, industrial production of insulin and other valuable medicines, methods of genetic transformation of plant protoplasts, cells and tissues, construction of the Agrobacterium tumefaciens Ti plasmid, introduction to the PCR method, plant transformation method using Agrobacterium tumefaciens and regulation of the production of genetically modified organisms. It is worth **30 points**.

The third block includes questions on systems competence, which test students' ability to synthesize and evaluate information. This question is a task involving the use of methods aimed at testing knowledge of the biolistic transformation of plants, the principle of operation of the gene gun, methods of genetic transformation of animals, legislation in the field of GMOs (domestic, foreign), patenting (legal regulation of the creation and use of GMOs), recombinant DNA and hereditary diseases, RNA interference: mechanism of action and prospects for use in medicine, mechanisms of gene expression regulation in prokaryotes and eukaryotes, gene therapy and personalized medicine. Worth **40 points.**

FINAL TEST ASSESSMENT GUIDE

Course: " Genetic engineering " Format: standard, written, Univer, offline.

Criterion	"Excellent" 20-25%	"Good" 15-20%	"Satisfactory" 10-15%	"Unsatisfactory" 0-10%
Understanding of the theories, concepts and technologies used in the field of genetic engineering.	Deep understanding of theories, concepts and technologies used in the field of genetic engineering.	Understanding theories, concepts and technologies in the field of genetic engineering. Links (citations) to key sources are provided.	Limited understanding of theories, concepts of professional identity and teacher professionalism. Limited references (citations) to key sources are provided.	Superficial understanding / lack of understanding of theories, concepts of professional identity and professionalism of the teacher. Relevant references (citations) to key sources are not provided.
Awareness of modern methods of genome analysis and recombinant DNA construction.	Has a good understanding of theories, principles and methods, key concepts and the role of genetic engineering in improving living organisms, the relationship between chromosomal engineering and genetic engineering and other modern technologies of human genome editing and gene therapy.	Limited awareness of genetic transformation techniques. Limited analysis of the topic, poorly supported by theoretical and empirical research.	Little awareness of genetic engineering methods. Little theoretical or practical research.	There is little or no connection between the concepts of a teacher's professional identity and the context of Kazakhstan. Little or no use of empirical research.
Definition of the area of practical application/recommendation	Offers sound policy and/or practical recommendations, proposals for improving the professional identity and professionalism of teachers in Kazakhstan.	Limited knowledge of genetic engineering techniques used in practice.	Limited policy and practical recommendations. Recommendations are non-essential, not based on rigorous analysis, and are shallow.	Little or no policy and practice advice, or advice of very low quality.
Presentation, teamwork	Excellent, attractive presentation, excellent quality of visuals, slides, materials, excellent teamwork.	Good engagement, good quality of visuals, slides or other materials, good level of teamwork.	Low level of engagement, low quality of materials, poor level of teamwork.	Lack of presentation and speech.

Example of calculating the final exam score

Letter grading system	Numbers equivalent to points	% content	Assessment according to the traditional system
A	4,0	95-100	Excellent
A-	3,67	90-94	
B+	3,33	85-89	Good
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	
C	2,0	65-69	Satisfactory
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
FX	0,5	25-49	Unsatisfactory
F	0	0-24	

Formula for calculating the final grade:

Final assessment $FO = \frac{\sum Б1}{\sum к} \times КВ1 + \frac{\sum Б2}{\sum к} \times КВ2 + \frac{\sum Б3}{\sum к} \times КВ3$

Where **Б** is the score for each criterion, **К** is the total number of criteria, and **КВ** is the question block coefficient. Based on the score obtained during the calculation, we can compare the assessment with the grading scale.

Thus, with this calculation, the project will be assessed at **87 points - "Good" - B+** in accordance with the point-rating letter system for assessing the academic achievements of students with their translation into the traditional grading scale and ECTS.

List of recommended sources

References: primary and secondary.

1. Prokofieva, D.S., Nurgalieva, A.Kh., Nadyrshina D.D., Khusnutdinova, E.K. Pharmacogenetics: textbook / D.S. Prokofiev – Ufa: RIC BashSU, 2017. – 97 p.
2. Grachev V.G., Sychev D.A., Ramenskaya G.V. Drug Metabolism. Scientific Foundations of Personalized Medicine (Guide for Physicians) GEOTAR-Media. 2018.
3. Krupitsky E.M., Akhmetova E.A., Asadullin A.R. Pharmacogenetics of chemical addictions. Scientific reviews // Review of psychiatry and medical psychology no. 4-1, 2019, 12 p.
4. Roseann S. Gammal, Pharm.D., BCPS; and Christy S. Harris, Pharm.D., FHOPA, BCOP Pharmacogenomics and Precision Medicine /PSAP 2020 BOOK. 22 p.
5. Ku-Lang Chang, MD, Kristin Weitzel, Siegfried Schmidt. Pharmacogenetics: Using Genetic Information to Guide Drug Therapy // American Family Physician October 1, 2015. V. 92, 7 www.aafp.org/afp (https://www.aafp.org/pubs/afp/issues/2015/1001/p588.pdf)

Research infrastructure

1. https://www.researchgate.net/publication/293876140_Farmakogenomika_s_osnovami_farmakogenetiki

Internet resources:

1. http://elibrary.kaznu.kz/ru
2. https://www.coursera.org/
3. https://www.edx.org/
4. http://elibrary.kaznu.kz/ru
5. https://www.isaaa.org/resources/publications/pocketk/16/
6. https://vc.ru/future/109057-gennaya-inzheneriya-sostoyanie-na-2020
7. https://sites.google.com/site/anogurtsov/lectures/ge